NAVAL AIR DEVELOPMENT CENTER

WARMINSTER PA 18974

REPORT NO. NADC-72098-VT 15 JUNE 1972

AIRFRAME INTEGRITY INVESTIGATIONS IN SUPPORT OF THE ANALYTICAL REWORK PROGRAM

PROGRESS REPORT

NAVAIRSYSCOM WORK REQUEST WR-25145
WORK UNIT GA8-2

UNCLASSIFIED

Security Classification

DOCUMENT CONTROL DATA - R & D

Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author) AIR VEHICLE TECHNOLOGY DEPARTMENT NAVAL AIR DEVELOPMENT CENTER WARMINSTER, PA. 18974	2a. REPORT SECURITY CLASSIFICATION UNCLASSIFIED 2b. GROUP

3. REPORT TITLE

AIRFRAME INTEGRITY INVESTIGATIONS IN SUPPORT OF THE ANALYTICAL REWORK PROGRAM

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)

PROGRESS REPORT

5. AUTHOR(S) (First name, middle initial, last name)

LOUIS ZERMAN

6. REPORT DATE	7a. TOTAL NO OF PAGES	7b. NO OF REFS
15 JUNE 1972	14	

8a. CONTRACT OR GRANT NO	9a. ORIGINATOR'S REPORT NUMBER(S)
b. PROJECT NO NAVAIRSYSCOM Work Request WR-25145 c. Work Unit GA8-2 d.	NADC-72098-VT 9b. OTHER REPORT NO(S) (Any other numbers that can be assigned this report)

10. DISTRIBUTION STATEMENT

APPROVED FOR PUBLIC RELEASE: DISTRIBUTION UNLIMITED

11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
	NAVAL AIR SYSTEMS COMMAND DEPARTMENT OF THE NAVY WASHINGTON, D. C. 20360

13. ABSTRACT

Airframe integrity investigations completed and/or initiated during fiscal year 1972 are reported on.

1a

DD FORM 1473

S/N 0102-014-6600

UNCLASSIFIED

14 KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Analytical Rework Program						
Airframe Integrity Investigations						
Structural Rework						
Structural Fatigue						

1b

DEPARTMENT OF THE NAVY
NAVAL AIR DEVELOPMENT CENTER
WARMINSTER, PA. 18974

AIR VEHICLE TECHNOLOGY DEPT.

REPORT NO. 72098-VT 15 JUNE 1972

AIRFRAME INTEGRITY INVESTIGATIONS IN SUPPORT OF THE ANALYTICAL REMORE PROGRAM

PROGRESS REPORT

NAVAIRSYSCOM WORK REQUEST WR-25145
WORK UNIT CAS-2

Airframe integrity investigations completed and/or initiated during fiscal year 1972 are reported on.

Reported by: Louis Berman
LOUIS BERMAN

Released by: C. G. Weeber
C. G. WEEBER
Supt., Structures Div.

TABLE OF CONTENTS

SUMMARY

Airframe structural integrity investigations are performed by the Naval Air Development Center, under the cognizance of the Naval Analytical Rework Program, to provide technical support to the Naval Air Rework Facilities. The goal of this support is to assist in defining structural incongruities, necessity and depth of rework required, and to prove the adequacy, integrity, and service life of aircraft components. The investigations completed and/or initiated during fiscal year 1972 are reported on.

INTRODUCTION

During their service use, Naval aircraft undergo major maintenance in the PAR (Progressive Aircraft Rework) which is performed by the NAVAIREWORKFAC's (Naval Air Rework Facilities). In the course of the PAR, many aircraft structural incongruities are uncovered. For example, corrosion, fatigue cracking, stress corrosion cracking, etc. A substantial amount of these discrepancies are discovered during the ARP (Analytical Rework Program) inspections. Solutions to overcome the structural problems take the forms of modifications, redesigns, and component replacements. This latter item, in many cases, precipitates a component shortage which may require extensive component rework to overcome. As a result of these changes and modifications it becomes extremely difficult to guarantee the structural adequacy, integrity, and fatigue life of the aircraft components.

The objective of the Airframe Integrity Investigation Work Unit, NAVAIRSYSCOM Work Request WR-25145, Work Unit GA8-2, reported on herein is to provide, under the Analytical Rework Program, aircraft structures technical support to the NAVAIREWORKFAC's. The goal of this support is to assist the NAVAIREWORKFAC's in defining structural incongruities, necessity and depth of rework required, realistic PAR norms, and to prove the adequacy, integrity, and service life of aircraft components. In addition, it is desirable to develop proper NDT inspection procedures to enable detection of structural discrepancies without extensive aircraft disassembly. Such information will affect the PAR manhours required, the PAR schedule, and the ARP inspection and analyses.

To provide the required technical support, the NAVAIRDEVCEN performs analytical investigations and destructive and nondestructive experimental investigations. Non-destructive inspection procedures are developed only for specific problem areas. The structural components which are investigated are those that a Naval Air Rework Facility believes to have structural problems, the solutions of which are beyond their capability. The investigations are accomplished in cooperation with the NAVAIREWORKFAC's.

The airframe integrity investigations completed and/or initiated during fiscal year 1972 are reported on herein. The investigations are listed by airplane model where appropriate. The order of listing bears no significance as to the importance of the investigation. As a matter of convenience this listing follows the order shown in the Naval Aviation News poster "U.S. Naval Aircraft Designations." A brief synopsis of each investigation is given. Details of an investigation can be gotten by referring, in some cases, to the references listed after each synopsis. In all cases, details are available by contacting the NAVAIRDEVCEN, Air Vehicle Technology Department; Mr. L. Berman, Code SA 5, Autovon 441-2436.

AIRFRAME INTEGRITY INVESTIGATIONS IN SUPPORT OF THE ANALYTICAL REWORK PROGRAM

FY-72 ARP PROGRAMS COMPLETED AND/OR INITIATED

RA-5C AIRPLANE

1. Due to the observance of stress corrosion cracks in the wing inboard panel rear spars and in the ribs at wing station 3.5 of some RA-5C model aircraft the NAVAIREWORKFAC JAX asked the following generalized questions: What would be the quantitative effects of shot peening the cracked/uncracked component? If necessary, is it feasible to perform tests to determine these effects? In response to these questions the NAVAIRDEVCEN performed an ARP investigation. It was found that quantitative data on the effects of shot peening is conspicuous by its absence; however, it is feasible to perform tests to gather this type of data for the particular RA-5C components in question.

Ref: (a) NADC ltr STH-5, 5074, 10 June 1971

2. In order to perform structural analysis of RA-5C arresting hooks, necessitated by hook failures, the NAVAIREWORKFAC JAX requested information on the time from hook engagement of the arresting wire to impact of the arresting hook bumper block with the bumper in the airframe. A quick-response time investigation was performed by the NAVAIRDEVCEN during which it was determined that the hook performs its maximum travel in .05 seconds.

Ref: (a) NADC ltr STH-5, 26, 4 Jan 1972

3. An investigation is underway to provide cognizant NAVAIREWORKFAC personnel a complete data history and data analysis package for their model airplane. A pilot program has been initiated in which all RA-5C operational service data and data analysis results generated at the NAVAIRDEVCEN has been compiled and collated. Samples of this data, which included maneuver loads, gust loads, landings, landing loads, arrestments, etc. were forwarded to NAVAIREWORKFAC JAX. Included in this package were data samples in various stages of analysis; unprocessed data, semi-analyzed data, results from special studies, and data analyses appearing in formal reports. The NAVAIREWORKFAC JAX personnel are currently reviewing this entire package for the purpose of determining which areas are of particular interest and searching for alternate approaches to analyzing or presenting these data.

Ref: (a) NADC ltr STC-21, 2667, 31 Mar 1972

A-6 AIRPLANE

1. The NAVAIREWORKFAC NORVA was tasked with the development of a rework/reinforcement for the A-6 lower wing skin fatigue failure at Wing

Station 60. Due to the uncertainty inherent in any fatigue repair, the NAVAIREWORKFAC requested the assistance of experienced NAVAIRDEVCEN fatigue test personnel relative to the testing/evaluation of the predicted/actual fatigue improvement of their reinforcement for the failure area. Consultant services were provided by the NAVAIRDEVCEN as requested. The following recommendation was made: "The NAVAIREWORKFAC NORVA proposed fix, with the slight beef-ups suggested, will adequately solve the fatigue problem for the localized failure area. However, the question as to whether this repair will cause a new area of the wing to become fatigue critical remains and should be considered part of the verall wing repair validation. Since the area of the present failure experiences complex loading, is extremely critical, and can fail catastrophically, a coupon/component type fatigue test could not adequately validate the integrity and life of the proposed fix. It is the contention of the NAVAIRDEVCEN that a full-scale wing fatigue test is required".

Ref: (a) NARF NORVA 161625Z Aug 71
(b) NADC ltr STH-5, 7083, 25 Aug 1971

A-7 AIRPLANE

1. The LTV Aerospace Corporation had recommended that the A-7 Unit Horizontal Tail Actuator Cylinders be replaced at approximately 2,000 flight hours. The NAVAIREWORKFAC JAX suggested that additional fatigue tests be performed to validate this service life figure. An investigation was begun at the NAVAIRDEVCEN to determine the number and types of tests required to establish the service life of the actuators. It was found that the fatigue life of actuators is associated with variables in the hydraulic system, such as synchronization pressures, fluid temperature, pressure excursions, servo-valve neutral pressure, and not from externally-introduced structural loads. Therefore, any tests necessary to determine the life of the actuators would be hydraulic in nature rather than structural. Accordingly, a test study plan has been proposed by the hydraulics personnel of the NAVAIRDEVCEN.

Ref: (a) NASCRL msg 201416Z March 71
(b) NASCHQ msg 182253Z May 71
(c) NADC msg 211336Z May 71
(d) NADC ltr STH-12, 5073 of 10 June 1971
(e) NADC spdltr MAEF 6286 of 26 July 1971

2. The NAVAIREWORKFAC JAX is considering a service life evaluation/extention program for the A-7 airplane. As such, consultant services were provided by the NAVAIRDEVCEN to advise on the requirements to be considered for the required full-scale wing fatigue test.

3. A joint NAVAIREWORKFAC JAX - NAVAIRTESTCEN - NAVAIRDEVCEN investigation was performed to determine the selection criteria and to select an A-7 airplane for use in a deep Structural Analytical Rework Program. As a result of this investigation A-7A Serial No. 152650 was selected for the ARP.

F-4 AIRPLANE

1. The NAVAIREWORKFAC NORIS has reported that the cockpit canopies of the F-4 aircraft are experiencing delamination type cracking at the edges. Because of the cracking, which is found on all edges of the canopy, the occurrence of which is not felt to be time dependent, canopy replacement is required. Due to the cost of canopy replacement and the fact that no in-service failures have occurred due to delamination cracking, the NAVAIREWORKFAC NORIS requested that the feasibility of performing tests to determine the damaged canopy safe life be investigated. The NAVAIRDEVCEN performed the requested investigation and determined that the canopy cracking could be caused by any or a combination of any of the following:

a. pressurization cycling
b. temperature gradients
c. differential in coefficients of thermal expansion between the acrylic and the fiberglass
d. excessive moisture
e. rough handling
f. low-speed, dull, or improperly sharpened drill when drilling fastener holes
g. maintenance chemicals
h. material deficiencies
i. torque of frame attachment bolts
j. out of tolerance between frame and glazing material

The investigation also determined that it was feasible to perform tests to determine the safe life of damaged canopies. It was further determined that there is a high probability of determining the canopy safe life by performing full-scale canopy, cyclic pressure tests (pressure being the only load parameter). A pressure only test program was deemed justifiable by NAVAIR and was authorized. To date18,000 pressure cycles have been applied with no noticeable detrimental effect to the canopies.

Ref: (a) NADC - ASD Report P29, "Test Plan Report for Structural Integrity Investigation of Delaminated F-4 Canopies in Support of the Analytical Rework Program," 24 Sept 1971.
(b) NADC ltr STH-5, 1720 of 1 March 1972

P-3 AIRPLANE

1. The lower steering collar of the P-3 nose landing gear has been cracking along the forging flash line and at 90° to the flash line. The NAVAIREWORKFAC Alameda believed that the 7075 aluminum alloy collar was cracking due to a build-up of internal residual stresses. It was requested that the NAVAIRDEVCEN investigate the availability of an NDT technique to measure these residual stresses. The initial investigation determined that of the possible NDT techniques (x-ray defraction, magneto absorption, ultrasonics, the Barkhousen device) none were fully working field applicable techniques. Certain techniques did show promise and are currently the subject of a follow on development investigation being conducted by the NAVAIRDEVCEN NDT personnel.

2. Fatigue life predictions have indicated that a number of P-3 aircraft have expended a high percentage of their fatigue life. As such, a program to inspect-in-detail the ten lead-the-fleet aircraft was proposed. It had been suggested that the first of these inspections be performed on a "crash" basis. An investigation was performed by the NAVAIRDEVCEN to evaluate the time response required for the inspections. The investigation indicated that it was not necessary to perform the first time inspection of the aircraft on a "crash" basis. It was found that it would be sufficient to inspect them as they came in for PAR. As a result of the investigation it was also recommended that, to be able to monitor and evaluate the effect of corrosion along with the anticipated possible structural fatigue damage, the aircraft to be inspected should consist of a combination of those with high fatigue life expended and those expected to have a high degree of corrosion problems.

Ref: (a) NADC ltr STH-5, 10833 of 30 Dec 1971

3. Upon the request of NAVAIR, NAVAIRDEVCEN personnel attended the P-3 PAR conference as the representative of AIR-4117. During the conference various maintenance problems were discussed as was the new PDLM requirements manual.

C-2 AIRPLANE

1. The C-2 aircraft has experienced in-service failures. The cause of the failures is believed to lie within the engine nacelle assembly. Therefore, an investigation has been initiated to determine the availability of data concerning the C-2/E-2 engine mounts. It is being contemplated to perform structural tests of said mounts.

C-130 AIRPLANE

1. An investigation by the NAVAIRDEVCEN of the structural integrity of the C-130 aircraft is continuing. Due to this investigation it was recommended that: The Navy either purchase new outer wings incorporating fatigue and corrosion modifications or join the USAF outer wing rehabilitation program. Have detailed inspections of the wings performed during the incorporation of the center wing modification in lieu of in-depth ARP's on the wing. Study a fatigue life monitoring program for the C-130 aircraft. NAVAIREWORKFAC personnel plan periodic in-person meetings with USAF/WRAMA personnel. In view of the NAVAIRDEVCEN investigation and in conjunction with a NAVAIR study, it is currently planned to take part in the outer wing rehabilitation program.

Ref: (a) NADC ltr STH-5 5798, of 7 Jul 1971
(b) NADC ltr STH-5 5813, of 7 Jul 1971
(c) NADC ltr STH-5 7084, of 25 Aug 1971
(d) NADC ltr STH-5 7944, of 27 Sep 1971

S-2 AIRPLANE

1. Due to a catapult fatigue test performed at the NAVAIRDEVCEN the NAVAIR put a limit of 750 catapult shots on the S-2 aircraft. Since the S-2 were fast approaching this limit, the NAVAIREWORKFAC requested from the NADC an interpretation of the fatigue test results as related to extensions beyond the test life. The NADC reviewed the test data and recommended that the number of catapult shots permissible could be safely extended beyond the test life of 750 shots, possibly to 1,000 catapults. It was also reiterated that a structural fix is required for the catapult keel.

2. Upon the request of NAVAIR, NAVAIRDEVCEN personnel attended a meeting at NAVAIR (AIR-5302 area) as the representative of AIR-4117. This meeting dealt with the S-2 catapult life and the required catapult keel structural "beef-ups".

3. Due to service failures of the exhaust system clamp of the R-1820 engine the NAVAIREWORKFAC requested the NAVAIRDEVCEN to perform an investigation to determine the feasibility of conducting a laboratory fatigue test of the exhaust system. This investigation determined that it is infeasible to perform laboratory tests due to the inability to duplicate the engine service loads in the laboratory.

Ref: (a) NADC ltr STH-12 1639 of 25 Feb 1972

E-1/C-1 AIRPLANE

1. Due to the failure of the S-2 catapult keel during laboratory tests and the requirement for life extensions, an investigation of the test requirements for determining and extending the catapulting and arrested landing lives of the E-1/C-1 aircraft was performed. It was recommended that tests be conducted and that they be conducted using an E-1 airframe. It was found that tests of the E-1 would suffice for the C-1. The reverse not being true.

2. Upon the request of NAVAIR, NAVAIRDEVCEN personnel attended a meeting at NAVAIR (AIR-5302 area) as the representative of AIR-4117. This meeting dealt with the E-1/C-1 catapulting and arrested landing fatigue lives. It was determined that a structural modification, similar to the S-2 planned modification, should be applied to the E-1/C-1 catapult keel. It was further determined that fatigue tests for the catapulting and arrested landing conditions of the modified airframe should be performed. It was agreed that if these tests were conducted using the E-1 airframe, they would suffice for the C-1.

E-2 AIRPLANE

1. Non-destructive inspection techniques, for utilization by the NAVAIREWORKFAC during the PAR are required to inspect the catapult and arrested landing carrythrough structure of the E-2. The opportunity to perform an in-depth study aimed at establishing these NDI techniques has been projected by the requirement for a full-scale E-2 airplane catapulting and arrested landing fatigue test. Accordingly NAVAIR (AIR-4117) requested an NDI investigation be performed during the fatigue test, which is to be conducted at the NAVAIRDEVCEN as a SLEP. In consideration of the significant benefits that can be derived by NARF participation in the formulation of the NDI plan, a joint NARF-NADC in-depth ARP has been proposed. An NDI program plan is currently being prepared for this ARP.

Ref: (a) NADC ltr STH-5 105 of 7 Jan 1972

H-2 HELICOPTER

1. In conjunction with a contractor conducted full-scale fatigue test of the H-2 airframe an ARP investigation was performed to gather data and define a test spectrum. The type of service data gathered is as follows: Airspeed, Altitude, Outside Air Temperature, N_z at the Center of Gravity, N_y at the Center of Gravity, Rotor RPM, Rotor Blade Lag Angle, Rotor Blade Flap Angle, and Landing Indications. Two hundred and fifty hours of data have been collected and reduced. This data will be forwarded to Kaman Aerospace Corp. for input into the fatigue test.

Ref: (a) NADC ltr STH-19 5840 of 8 Jul 1971
(b) NADC ltr STH-19 9535 of 8 Nov 1971

2. Concurrent with the full-scale fatigue test of the H-2 airframe an ARP investigation is being performed to determine realistic replacement times for the dynamic components not covered by the test. These are: the main landing gear and carrythrough structure, the engine mount and carrythrough structure, the auxiliary landing gear and carrythrough structure, and the non-rotating control system. To date the landing gear and engine mounts and their carrythrough structure have been analyzed. It has been determined that the lives of these components are well in excess of the required lives.

In conjunction with the above investigation a second study was performed in which the H-2 airframe inspection records and the Navy 3M data were reviewed. This study was to determine specific problem areas and make recommendations to change the present PAR requirements for those problem areas. The results of this study are such that twenty-eight problem areas in the airframe, six in the fuselage compartments, three in the landing gear, and three in the flight controls have been documented.

Ref: (a) NADC ltr STH-12 1742 of 1 Mar 1972
(b) Kaman Aerospace Corp. Report No. R-983, "H-2 Helicopter Analytical Rework Program Data Survey Task," of 21 Jan 1972

H-3 HELICOPTER

1. In response to a request from the NAVAIREWORKFAC Quonset Point an investigation was performed to determine the availability of data concerned with the service life of the H-3 airframe and the integrity of the tail pylon hinge fittings and the Quick Engine Change (QEC) items. It was determined that the only information concerning the above three topics is contained in Sikorsky Aircraft Report SER-61483, "Fatigue Test of the SH-3A Airframe Structure," of 8 Jan 1964. A copy of this report was procured and forwarded to the NARF.

Ref: (a) NADC ltr STH-12 1639 of 25 Feb 1972

H-46 HELICOPTER

1. During the investigations following two in-service failures of the CH-46 helicopter (one in 1967 and one in 1971) it was determined that the accidents resulted due to aft rotor blades desynchronization. It was further observed that the self-locking bearing retainer nut on the aft transmission planet carrier was disengaged. Since disengagement of this nut could have caused the desynchronization of the aft rotor the NAVAIREWORKFAC Cherry Point has requested the NAVAIRDEVCEN to conduct a test program involving the self-locking nut. This test program will address itself to the question as to whether or not the self-locking nut could become disengaged from the planet carrier by being "popped off" during service as a result of impact loading imposed during landings. A test plan for this program is currently being written and will be submitted to NAVAIR for program approval.

Ref: (a) NARF CHERPT msg 212141Z Mar 72
(b) NADC msg 2321082Z Mar 72

T-28 AIRPLANE

1. An investigation to define the requirements for determining the integrity of the T-28 B/C Airframe to sustain a service life extension was performed. As a result of this investigation it was determined that a full-scale airplane fatigue test is required to justify a service life extension. It was recommended that the test be performed using a fully modified aircraft. That is, one that incorporates all service modifications plus the "fix's" required to repair the structural cracks at wing stations 2 and 75.

Ref: (a) NADC ltr STH-5 7611, 14 Sep 1971

2. The NAVAIREWORKFAC PMCLA was directed by NAVAIR to submit a plan for a Service Life Extension Program for the T-28 B/C airplane. As a part of this plan the NAVAIREWORKFAC requested the NAVAIRDEVCEN to formulate and submit a definition, cost and schedule for a fatigue test program aimed at extending the service life of the T-28. A test program was outlined in detail and forwarded to NAVAIREWORKFAC PMCLA. The program outline specified which model T-28 should be tested, what modifications should be incorporated in the test article, what tests should be run, and time and cost estimates for the testing. The basic information from this test program plan was subsequently included in the NAVAIREWORKFAC PMCLA, officially submitted, T-28 Aircraft Service Life Extension Program.

Ref: (a) NADC ltr STH-5 7992, 28 Sep 1971
(b) NADC ltr STH-5 9386, 2 Nov 1971
(c) NARF PMCLA Speedletter Code 31C of 26 Oct 1971

STRESS COINING - ALL AIRCRAFT

1. An investigation of a stress coining procedure for increasing the fatigue life of aircraft structures was initiated upon the request of NAVAIRSYSCOMREPAC. There are three methods of stress coining, developed by McDonnell Douglas Corp., being investigated. They are: "Radius Stress Coining," "Pad Stress Coining," and "Stress Coin Hole Expansion." The stress coining procedure produces local residual compressive stresses in the material. These compressive stresses theoretically prolong the fatigue life by decreasing the local mean stress at a point where cracking begins. It is the intention of this investigation that if stress coining is found to be satisfactory this procedure will be recommended for introduction to the NAVAIREWORKFAC's as a standard technique.

Ref: (a) NASCRP msg 201051Z Nov 71
(b) NASCRP msg 230903Z Nov 71
(c) NADC ltr STH-5 1061, 4 Feb 1972
(d) NASCRL Spdltr 3370/4730/93, 14 Feb 1972
(e) NADC Spdltr STH-5 2027, 10 Mar 1972
(f) NASC ltr AIR-530215/109:APC, 12 Mar 1972
(g) NADC ltr STH-5 4002, 9 May 1972

DISCUSSION

A close inspection of the Structures ARP programs completed and/or initiated by the NAVAIRDEVCEN during the fiscal year 1972 reveals that the majority of investigations were analytical in nature. In actuality they primarily involved aircraft structures engineering consulting in the area of structural fatigue. For example, recommending, determining the requirements for, and developing test plans for full-scale structural fatigue tests of in-service aircraft. The aircraft either having been greatly reworked and requiring fatigue testing to determine the service life, or having reached its service life and requiring a life extension (see T-28 write-up, Items 1 and 2). At the initiation of the structures ARP program it was anticipated that the NAVAIRDEVCEN would be able to assist the NAVAIREWORKFAC's in solving numerous small structural problems. For example, how has the mission capability of a wing spar been changed due to a localized repair for stress corrosion cracking? Problems of this nature would require analytical investigations, and destructive and non-destructive tests. This has not been the case. Some destructive and non-destructive test investigations have been performed but, as indicated above, these have been the exception rather than the rule. An analysis to determine the "why's" and "wherefore's" of this situation reveals a many faceted answer. The two prime facets of the answer are 180 degrees apart and are: (1) The exceptional structural engineering capability of the NAVAIREWORKFAC's, particularly in the field of structural repairs and (2) the lack of knowledge and information at the NAVAIREWORKFAC's as concerns structural fatigue and the effect of rework on the fatigue life of a structure. This lack of capability in the area of structural fatigue has been recognized to some degree by the NAVAIREWORKFAC's. As such, the NAVAIRDEVCEN's prime area of structures assistance to the NAVAIREWORKFAC's becomes a matter of providing engineering consulting in the field of structural fatigue and the performance of full-scale structural tests of components and entire aircraft. Another facet of the answer is that, unlike other areas relating to an aircraft, new technologies and techniques concerned with structures are comparatively rapidly transferred from R&D to actual use. This indicates that in the structures areas the R&D activities are, and have been, fulfilling their obligations of service to the fleet.

CONCLUSIONS AND RECOMMENDATIONS

As is readily apparent from the airframe integrity investigations reported on herein, the NAVAIRDEVCEN's structural ARP program has had a significant impact on the maintenance of Naval Aircraft as performed by the NAVAIREWORKFAC's. It is therefore recommended that this program continue even though modified somewhat to reflect the major NAVAIREWORKFAC requirements as concerns external structures assistance. These requirements are: (1) the performance of structural engineering consulting in the area of structural fatigue and in general, and (2) the performance of full-scale component and aircraft fatigue tests.

It is further recommended that all structural fatigue data available (contractor, NAVAIR, etc.) on Naval Aircraft be disseminated to the cognizant NAVAIRWORKFAC's. Additionally, it is highly recommended that R&D type engineers be encouraged to visit the NAVAIRWORKFAC's, at least once in their working career. It is felt that this, more than any slogan, will drive home the necessity of the statement, "What have you done for the fleet, today?"